UCRL-JC-120244 ABS

X-ray laser backlighting applied to measure laser imprint*

D.H. Kalantar, L.B. DaSilva, S.G. Glendinning, M.H. Key[1],
F. Weber, and S.V. Weber
Lawrence Livermore National Laboratory

J.P. Knauer
Laboratory for Laser Energetics, University of Rochester

For direct drive ICF, a capsule is imploded by directly illuminating the surface with laser light. The beam smoothing and uniformity of illumination affect the seeding of instabilities at the ablation front and affect the overall stability of the implosion.

Measurements of the effect of laser imprint on a flat CH foil have previously been made by recording the perturbation amplitude during the phase when it is dominated by Rayleigh-Taylor growth. This measurement is a convolution of laser imprint and the Rayleigh-Taylor growth, and it does not give any information about a time history of the imprint. The effect of imprint is expressed in terms of an equivalent surface perturbation amplitude.

We have developed a new technique for studying the imprint of a laser beam on a thin foil. We use an Yttrium x-ray laser as a XUV backlighter. This is relayed via multilayer optics onto a thin Si foil. The foil is then imaged onto a CCD camera to measure the optical depth modulation due to laser imprint when the shock breaks out. By using an XUV backlighter to image a Si foil, we are able to measure small fractional variations in the foil thickness, so we can measure modulations due to laser imprint during the imprint phase.

We recorded images due to imprint from a $5x10^{12}$ W/cm^2 3w drive beam incident on a 3 mm Si foil. We show the modulation at the time of the shock breakout corresponds to a 4% RMS modulation in the initial thickness of the foil. We compare the cases of narrow bandwidth and broad bandwidth laser drive and compare both with Lasnex simulation.

[1] On leave from Rutherford Appleton Laboratory, UK.

* This work was performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract No. W-7405-ENG-48.